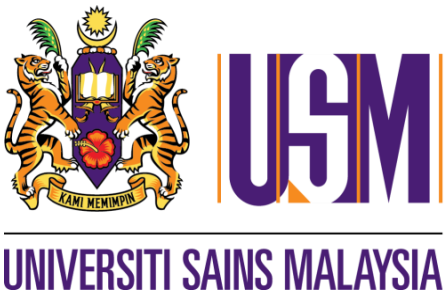

EFFECT OF DIFFERENT PRE-TREATMENTS ON FUNCTIONAL AND PHYSICOCHEMICAL PROPERTIES OF OCTENYL SUCCINIC ANHYDRIDE (OSA) MODIFIED SAGO STARCH IN PICKERING EMULSION

by

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DECLARATION BY AUTHOR

This dissertation is composed of my original work and contains no material previously published or written by another person except where due to reference has been made in the text. The content of my dissertation is the result of work I have carried out since the commencement of my research project and does not include a substantial part of work that has been submitted to qualify the award of any other degree or diploma in any university or tertiary institution.

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LIST OF ABBREVIATIONS

Abbreviation	Caption
α	alpha
β	beta
θ	Theta
°	Degree
°C	Degree Celsius
%	Percent
ANOVA	Analysis of Variance
AOS	Acid hydrolysis OSA modified sago starch
cm^{-1}	Per centimetre
DP	Degree of Polymerization
DS	Degree of Substitution
EA	Emulsifying Activity
FDA	Food and Drug Administration
FTIR	Fourier Transform Infrared Spectroscopy
g/mol	gram per moles
g	gram
h	hour
ha	hectare
HCl	Hydrochloric acid
HOS	High ultrasonic OSA modified sago starch
KBr	Potassium bromide
kV	kilovolt
m	meter

mA	milliampere
mg/mL	milligram per millilitre
min	minute
mL	millilitre
mol/L	moles per litre
nm	nanometre
N	Normality
NaOH	Sodium hydroxide
NS	Native starch
OSA	Octenyl succinic anhydride
OS	OSA modified sago starch
O/W	oil in water
r/min	revolutions per minute
SEM	Scanning Electron Microscopy
s	second
µL	microlitre
µm	micrometre
v/v	volume/volume
W/O	water in oil
w/v	mass/volume
w/w	mass/mass

KESAN PELBAGAI PRA-RAWATAN PADA SIFAT DAN FIZIKOKIMIA OKTENIL SUKSINAT ANHIDRAT (OSA) MODIFIKASI KANJI SAGU

ABSTRAK

Emulsi yang stabil, atau lebih dikenali sebagai emulsi 'Pickering', boleh dihasilkan dengan menggunakan kanji. Kajian ini bertujuan untuk memahami bagaimana sifat-sifat kanji mempengaruhi saiz titisan dan pengkriman emulsi tersebut. Dalam kajian ini, kanji sagu *(Metroxylon* spp.*)* dirawat terlebih dahulu dengan dua kaedah yang berbeza untuk menstabilkan emulsi 'Pickering' (mayonis). Ultrasonikasi kuasa tinggi dan hidrolisis asid digunakan untuk mendapatkan saiz kanji yang lebih kecil. Semua sampel diesterifikasi dengan 3% oktenil suksinat anhidrat (OSA) untuk meningkatkan hidrofobik mereka. Darjah penggantian (DS) adalah yang tertinggi (0.0206) untuk AOS dan 0.0123 untuk HOS. Berbanding kanji asli, spektroskopi FTIR menunjukkan bahawa kanji sagu OSA yang dirawat terlebih dahulu mempunyai dua penyerapan tambahan pada 1725 cm^{-1} dan 1570 cm^{-1}. Morfologi granul kanji sagu yang diperiksa menggunakan mikroskop elektron imbasan (SEM) menunjukkan beberapa permukaan yang kasar, kavitatsi dan hakisan pada kanji sagu OSA yang telah dirawat. Indeks emulsi (EI) meningkat untuk kanji sagu OSA yang dirawat terlebih dahulu kerana pengurangan saiz kanji. Mayonis dengan kepekatan 75% dan 100% pra-rawat sagu OSA mengekalkan emulsi mereka stabil selepas 21 hari berbanding sampel lain yang mula berkrim. Aktiviti pengemulsi (EA) mayonis yang stabil dengan kanji sagu OSA yang dirawat terlebih dahulu menunjukkan saiz titisan yang lebih kecil dengan perbezaan yang ketara *($p < 0.05$)* berkenaan dengan gangguan struktur yang berlaku semasa pra-rawatan dan pengubahsuaian. Oleh itu, pra-rawatan telah berjaya menghasilkan permukaan aktif pada kanji sagu asli dan kanji sagu OSA yang berguna untuk digunakan dalam emulsi.

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ABSTRACT

Particle-stabilized emulsions, called Pickering emulsions, can be produced by using starch particles. This work aims to understand how the properties of the starch particles affect the droplet size and creaming of such emulsions. In the study, sago starch *(Metroxylon* spp.*)* particles were pre-treated by two different methods and used to stabilize Pickering emulsion (mayonnaise). High power ultrasonication and acid hydrolysis pre-treatments were used to obtain smaller particles. All samples were modified with octenyl succinic anhydride (OSA) to increase their hydrophobicity with a level of OSA substitution of 3%. Degree of substitution (DS) was the highest (0.0206) for AOS and 0.0123 for HOS. In comparison to native starch, FTIR spectroscopy showed that pre-treated OSA sago starch had two additional bands at 1725 cm^{-1} and 1570 cm^{-1}. The morphology of sago starch granule examined using scanning electron microscopy (SEM) showed some rough surface, cavitation and erosion on OSA sago starch. The emulsification index (EI) increased for the pre-treated OSA sago starch owing to the size reduction of starch particles. Mayonnaise with 75% and 100% pre-treated OSA sago starch kept their emulsion stabilize after 21 days while mayonnaise formulated with OSA sago starch exhibited creaming. The emulsifying activity (EA) of mayonnaise stabilized with pre-treated OSA sago starch showed smaller droplet size with significantly difference *($p < 0.05$)* with respect to structural disorder that occurs during pre-treatments and modifications. Therefore, the pre-treatments have improved native sago starch and OSA sago starch becoming surface active molecules which will be useful to be used in emulsion.